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CHEMISTRY OF NANOSIZED TUBULAR CLAY MINERALS

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Natural and synthetic clays and clay minerals are a very big family with different structures, morphologies and properties. Clays, usually kaolins containing mainly kaolinite with laths morphology, are the oldest know pottery materials used in prehistory. As early as 1930, based on observation of the structure of asbestos-related minerals, Pauling proposed the existence of cylindrical structures formed by minerals in nature. This presentation will focus on two examples of such less known rolled clay minerals with tubular nanostructures. These nanosized tubular clay minerals have at least one dimension in the nano range (between 1 and 100 nm) and a hollow tubular structure. Halloysite which is mainly used after extraction from soils has an internal aluminol surface. Imogolite can be also extracted from soils derived from weathered volcanic rocks, has an external aluminol surface. This opposite structural arrangement of the two nanoclay minerals leads to completely different properties. Moreover, halloysite appears very difficult to synthesise but it is easy to prepare synthetic imogolite nanotubes which are monodisperse in diameter (from 2 to 4 nm depending on composition) and polydisperse in length from several tens of nanometers up to several microns.

Thanks to microscopic and spectroscopic methods, the structures of some nanosized tubular clay minerals, such as halloysite and imogolite have been identified since the 50's. However, there was very little research on nanosized tubular clay minerals, and relevant papers were published only occasionally. The renewed interest since the 90's in nanosized tubular clay minerals can be partially attributed to the boom in studies on nanostructured materials and related applications, with the first synthesis of carbon nanotubes and several other nanotube materials (e.g., MoS_2 and BN). In the context of environmental science and technology, interest has been focused on using these low-cost and environmentally friendly natural materials as adsorbents for remediating pollution. This application is made possible by the high surface activity and amenability to surface modifications for versatile types of pollution treatment.

Reference:
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